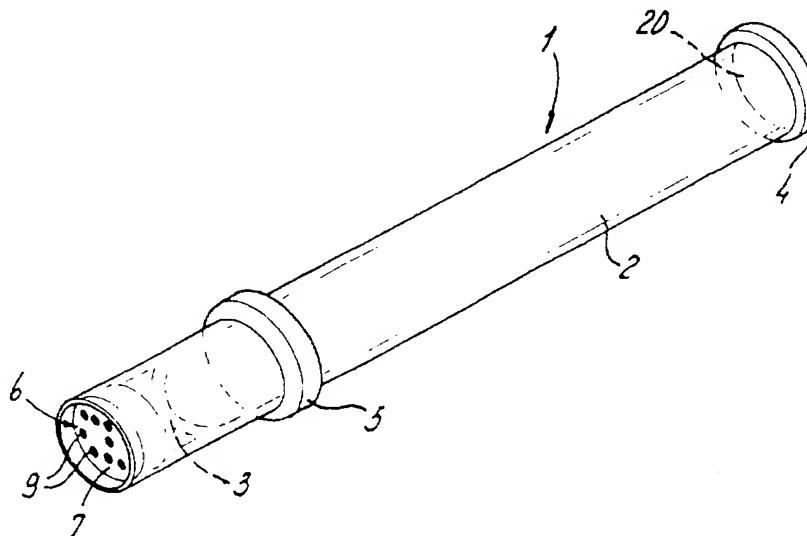




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>B01L 3/14, 9/06, G06K 19/06</b>		A1	(11) International Publication Number: <b>WO 98/05427</b>
			(43) International Publication Date: 12 February 1998 (12.02.98)
(21) International Application Number: PCT/NL97/00447 (22) International Filing Date: 30 July 1997 (30.07.97) (30) Priority Data: 1003726                      1 August 1996 (01.08.96)                      NL (71) Applicant (for all designated States except US): MICRONIC B.V. [NL/NL]; P.O. Box 604, NL-8200 AP Lelystad (NL). (72) Inventors; and (75) Inventors/Applicants (for US only): WIJNSCHENK, Ronald, Josephus, Clemens [NL/NL]; Dille 7, NL-8252 CJ Dron-ten (NL). KRAMER, Bartholomeus, Wilhelmus [NL/NL]; Kamp 43-29, NL-8225 HT Lelystad (NL). (74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooi-bureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  Published With international search report. In English translation (filed in Dutch).	

(54) Title: TEST TUBE WITH OPTICALLY READABLE CODING



## (57) Abstract

The invention relates to a test tube comprising a tubular container, which tubular container at its bottom end is provided with an optically readable coding such as a dot code, and in which the optically readable coding is applied to an optically substantially opaque surface. The optically opaque surface is preferably substantially flat and faces downwards. For constructional reasons it is very advantageous if the optically opaque surface is applied to a carrier part fixed to the bottom end of the tubular container. The invention also relates to a rack with a multiplicity of accommodation positions for accommodating test tubes according to the invention therein, the accommodation positions being optically open at the underside. The invention further relates to an assembly comprising a rack according to the invention and an optical reading mechanism for reading the optical codings on the underside of the test tubes according to the invention placed in the rack.

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

## TEST TUBE WITH OPTICALLY READABLE CODING

The present invention relates to a test tube, comprising a tubular container, which tubular container at its bottom end is provided with an optically readable coding such as a dot code.

5 A container resembling such a test tube is known from WO 94/02857.

A test tube in this case should be understood as meaning a container for storing substances, as well in liquid form, as in powder form as in solid form, for chemical analyses, sample storage etc. Such  
10 test tubes can range in size from small test tubes, for example test tubes with a capacity of 0.2 ml, to large test tubes with a capacity of 10 ml or more.

Test tubes are commonly used for storing samples, such as blood samples of humans and animals, for possible subsequent analysis. Such  
15 samples may be divided among a number of test tubes if necessary. In addition, many samples are stored for other purposes. In the case of all these applications it is extremely important to be able to code the test tubes, in order to be able to keep a record of the contents of each test tube. The test tubes are generally arranged in the racks in an 8 x 12  
20 configuration, so that each rack contains 96 test tubes. It is known to allocate a position code to each test tube in the rack by numbering the rows and columns. The eight rows are then numbered, for example, A to H, while the twelve columns are numbered 1 to 12. In this way, depending on the position in the rack, each test tube can be given its own code, for  
25 example A1, C7, H9 etc. Such a coding is generally not indicated on the tubes, but along the sides of the rack. Such a coding may also be indicated on the tube itself, if desired, this being of benefit only if the tube does not form a fixed part of the rack. These codings are designed to be read with the human eye. These codings are applied  
30 directly to the transparent test tube, which has the disadvantage that in the case of certain substances the coding is very difficult or impossible to read.

A container bearing some resemblance to the test tube of the type mentioned at the beginning is known from International Patent  
35 Application WO 94/02857. This publication relates to a "reagent bottle identification and reagent monitoring system for a chemical analyzer". In this case, in a chemical analyzer use is being made of reagent bottles which at their top end are provided with a narrowed neck and at their

bottom end are provided with a dot code at the downward facing surface of the bottom. This dot code is applied to a printed label which can be fixed by means of an adhesive to the downward facing surface of the bottom. According to a preferred embodiment, each label here has a light-  
5 coloured background on which a contrasting pattern of dots is printed. As stated in this publication, smallest dot sizes with a diameter of approximately 850  $\mu\text{m}$  can be achieved here, while the surface required for the dot code must have a diameter of at least approximately 13 mm.

The object of the present invention is to provide a coded test  
10 tube, preferably a uniquely coded test tube, in the case of which the coding is readable at all times.

This object is achieved according to the invention with a test tube comprising a tubular container, which tubular container at its bottom end is provided with an optically readable coding such as a dot  
15 matrix, characterized in that the optically readable coding is applied to an optically substantially opaque surface, in other words, an optically substantially opaque background with a surface bearing the coding. Applying the optically readable coding to an optically substantially opaque background ensures that the optical coding is readable at all  
20 times with an optical reading mechanism, irrespective of the substance present in the generally transparent test tube. If the surface or the background is not or is insufficiently optically opaque, errors could occur during reading of the code, as a result of reflections coming from the substance present in the test tube. By applying the optically  
25 readable coding at the bottom end of the test tube, simple automated reading of the coding with the aid of an optical reading mechanism is made possible. For the test tube need only be held with its bottom end towards an optical reading mechanism, which is then possible in principle while the test tube is still in a rack, even if a number of test tubes  
30 are situated next to each other in the rack.

In order to be able to read the optically readable coding from underneath with great certainty, it is advantageous according to the invention if the optically substantially opaque surface is substantially  
35 flat and faces downwards, and extends substantially in the crosswise direction of the tube. Making the surface flat ensures that the risk of errors during the automated optical reading of the coding is minimized by avoiding optical deformations, and providing the surface facing downwards at the bottom end of the tubular container ensures that the circumferential measurements of the tubular container can remain

substantially unchanged.

Since, on account of their material properties, not all test tubes can be provided with an optically opaque surface, i.e. an optically opaque background, applied directly thereto, and not every test tube material is so suitable for direct application of a coding thereto, it is advantageous according to the invention if said surface is applied to a carrier part fixed to the bottom end of the tubular container. Such a carrier part according to the invention can be fixed to the tubular container if the tubular container comprises retaining means, such as a retaining lug or retaining recess, at its bottom end, but it is also very conceivable for the carrier part to be glued or stuck or pressed onto the tubular container.

According to a special, advantageous embodiment, the carrier part will be made of a material which is different from the material from which the tubular container is made and which is suitable for the application of the optically readable coding. This makes it possible to continue using materials which have proved very suitable for the actual test tube itself, such as in particular optically transparent materials, and still to provide said test tube with an optical coding which is easily readable in all circumstances.

In order also in particular to be able to provide very small test tubes - for example, having a diameter of approximately 8.5 mm and smaller - with a coding which is unique for the test tube in question, it is very advantageous according to the invention if the material of the carrier part is suitable for burning in the optically readable coding by means of a laser technique, which coding in this case is preferably a fine dot code. What is meant here by a fine dot code is a code in which the centre-to-centre distance between adjacent dots is less than 0.5 mm, preferably 0.4 to 0.35 mm or less. With such a laser technique, dots with a diameter of less than approximately 200 µm, for example approximately 150 to 175 µm, can be achieved in the case of a carrier part made of a material suitable for the purpose. An average person skilled in the art will be able to name widely varying suitable materials for the carrier part which not only permit the application of such a fine dot code by a laser technique which is known per se, but also provide an optically opaque background for trouble-free reading of the dot code. Polystyrene, possibly provided with a suitable filling agent or filling substance, can be mentioned as an example of such a suitable material. Another example which can be mentioned is ABS (acrylonitrile butadiene styrene), which in

itself has a white basic structure and lends itself very well to burning in a very fine dot code by means of a laser technique. Other plastics, for example filled with titanium white or zinc white, seem suitable for burning in a very fine dot code by a laser technique, but plastic to  
5 which  $\text{TiO}_2$ -coated ground mica particles are added are also very suitable for this purpose.

The carrier part according to the invention can advantageously be a part moulded onto the tubular container, such as a gated plastic part. Plastics are relatively easily gated into other plastics or other  
10 materials, retaining means or interlocking means possibly being provided so that they remain joined to each other.

According to the invention, the carrier part can be designed in many different ways. For example, according to the invention it is very conceivable for the carrier part to comprise at its top side a cavity in  
15 which the bottom end of the tubular container is accommodated and is fixed to the carrier part by means of a snap connection. However, it is also very conceivable for the carrier part to be accommodated in the tubular container, by extending the side wall of the tubular container at its bottom end until it is beyond the bottom of the tubular container, in  
20 order to form a space below said bottom for accommodating the carrier part. In order to be able to confine a carrier part in this space, it is advantageous according to the invention in this case if at the bottom end of the extended side wall at least one retaining lug pointing into the space or at least one retaining recess which opens towards the space is  
25 provided. The carrier part can then be fitted in the space and the retaining lug or retaining recess will prevent the carrier part from coming out of the space.

According to an advantageous embodiment, the carrier part in this case is a plastic part injected into the space. Such a plastic part  
30 can then be injected into this space after or during the manufacture of the test tube. If this carrier part is injected into the space during or after or immediately after the manufacture, co-moulding processes suitable for this purpose which are known per se from the prior art can then be used. The plastic part in this case can be a plastic which is  
35 selected for its properties in connection with the application of the optically readable coding thereto. The optically readable coding must be able to adhere to this plastic part, and this plastic part must provide an optically substantially opaque surface, which is readily achievable by using a non-transparent, i.e. opaque, plastic. According to another

advantageous embodiment of the invention, the carrier part is an element which is fixed by snapping between the at least one retaining lug and a further stop member, such as the bottom of the tubular container. Such an element can therefore then be fitted in the space formed below the bottom  
5 of the tubular container after the test tube has been formed, by pressing said element into it, after which a snap-in lock holds the element in place.

According to a further advantageous embodiment of the test tube according to the invention, at its bottom end the tubular container is  
10 provided with an annular groove formed on the outside, which groove preferably extends over at least part of, but preferably over the entire circumference of the container, and at its bottom end the tubular container is further provided with one or more, preferably two, three or four, channels extending from the annular groove to substantially the  
15 bottom end of the tubular container, and the carrier part comprises:

- a plate situated at the bottom end of the tubular container;
- arms extending from the plate through the channels to the annular groove; and
- a ring extending through the groove;

20 the plate, the arms and the ring being formed integrally from plastic, and the arms and the ring retaining the plate at the bottom end of the container. Making the bottom end of the container in such a way means that the so-called carrier part can easily be applied as a moulded-on part by an injection moulding technique, a reliable permanent fixing of  
25 the carrier part to the tubular container being ensured by the ring, which bears the plate (to which the coding can be applied) by way of the arms. According to a further advantageous embodiment, the channels in this case are grooves formed in the outside wall of the container. This makes it possible also to produce the tubular container as an injection  
30 moulded product. It is particularly advantageous here if the carrier part accommodates the bottom end of the container in a close-fitting manner as a sort of basket, the free spaces in the wall of the basket-type part (i.e. the spaces between the grooves/channels/arms) accommodating projecting parts at the bottom end of the container. A reliable, simple  
35 and sturdy retention of the carrier part on the tubular container is thereby ensured.

According to an advantageous embodiment, the tubular container can be made of a polypropylene or polypropene or other plastic suitable for test tubes. Types of polypropylene or polypropene suitable for test

tubes are generally known from the prior art. Types of polypropylene or polypropene suitable for test tubes form a generally unsuitable substrate for an optically readable coding, unless something is added for such a coding.

5 A test tube according to the invention is also preferably transparent.

The invention also relates to a rack, in particular a storage and/or transportation rack, with a multiplicity of accommodation positions for accommodating test tubes according to the invention  
10 therein, the accommodation positions being optically open at the underside, in such a way that the optically readable coding of test tubes to be placed therein can be read from the "underside" of the rack with an optical reading mechanism. What is meant in this case by "underside" of the rack is the underside of the rack viewed from the orientation of the  
15 test tubes, the side of the rack where the bottom ends of the tubular containers are situated then forming the underside of the rack. Such a rack has the advantage that the test tubes placed therein can be read by means of an optical reading mechanism without the test tubes first having to be removed from the rack. According to a further special embodiment, 20 such a rack comprises test tubes according to the invention in at least a number of the accommodation positions, possibly in all accommodation positions. In particular, the rack can have 96 accommodation positions placed in a 12 x 8 matrix pattern. The test tubes in this case can be small test tubes with a diameter of approximately 8.5 mm and a centre-to-  
25 centre distance of approximately 9 mm, for example 8.5 to 9.5 mm, between adjacent test tubes. What is meant in this case by centre-to-centre distance is the distance between the longitudinal axes of adjacent test tubes.

The invention also relates to an assembly comprising a rack  
30 according to the invention, test tubes according to the invention and an optical reading mechanism for reading the optical codings on the test tubes.

The invention also relates to an assembly comprising a rack according to the invention and an optical reading mechanism, the optical  
35 reading mechanism comprising a supporting frame for supporting the rack to be placed thereon, in which a multiplicity of substantially vertically oriented test tubes can be placed, and a reader fitted in the supporting frame and reading substantially in the vertical, upward direction. Such an assembly of a rack and an optical reading mechanism makes it possible



to place a fully or partially filled rack on the reading mechanism and to have the optical codings of the test tubes placed in the rack automatically read out by the reader. The reading mechanism in this case will preferably be provided with a microprocessor which is equipped to

5 allocate the codes which have been read to the accommodation position in the rack. This makes it possible, by means of suitable display means, to obtain information on the position of a particular test tube in the rack. In order to be able to establish unequivocally the position of the test tubes in the rack, it is advantageous according to the invention if the

10 rack and the optical reading mechanism are provided with means for unequivocally determining or recording the position or orientation of the rack relative to that of the reading mechanism or the frame thereof. Such means can comprise a further optical coding which is applied to the underside of the rack, and which is then readable by the reading

15 mechanism, but it is also very conceivable for such means to comprise mechanical means which ensure that the rack can be placed only in one position on the frame, or which make it possible to place the rack in an unequivocally determined position on the frame of the reading mechanism.

It is also advantageous if a switch which emits a "correct" or

20 "incorrect" signal or both types of signals is activated, for example by means of a lug or notch, when the rack is positioned correctly or incorrectly respectively.

The optical coding used according to the invention is preferably a unique coding, i.e. a coding system by means of which a

25 virtually infinite number of unique codings can be achieved. Such a coding system can comprise a so-called bar code, but will preferably consist of a matrix-like pattern of dark and light dots, i.e. a matrix-like pattern in which all matrix points are dark or light, for example black or white. Such a coding made up of a dot matrix can also be

30 indicated by the term dot array and is also sometimes called a dote code. Theoretically, it is then possible with, for example, a 5 x 5 matrix to achieve approximately 33 million ( $2^{25}$ ) unique codings, and with a 7 x 7 even  $2^{49}$  (approximately  $5.6 \cdot 10^{14}$ ) different unique codes can be

35 achieved. However, it will be clear that matrices with an uneven number of rows and columns can also be used, as can other figures based on a dots pattern. For instance, it is also conceivable to achieve a dot coding on the basis of a number of concentric dot circles, or on the basis of a spiral-shaped pattern of dots. Usable dot codings are known per se from the prior art.

The present invention will now be explained in greater detail with reference to exemplary embodiments shown in the drawing, in which:

Fig. 1 shows a perspective view of a test tube according to the invention;

5 Fig. 2a shows a longitudinal sectional view of the test tube shown in Fig. 1;

Fig. 2b shows a detail view of the bottom end of a test tube according to a further variant of the invention;

10 Fig. 3 shows a view in disassembled parts of a rack according to the invention, which rack is provided with a multiplicity of accommodation positions for test tubes;

Figs. 4 and 5 show two detail views of a rack from Fig. 3 completely filled with test tubes, the locking element being shown in the releasing and locking positions;

15 Fig. 6 shows a diagrammatic, perspective view of an assembly according to the invention, comprising a rack and an optical reading mechanism; and

20 Fig. 7 shows a perspective view, with disassembled parts, of the bottom end of an embodiment of a test tube according to the invention.

Fig. 1 shows a test tube 1. Said test tube 1 consists substantially of a tubular container 2 having at its top end a filling aperture 20 which may be shut off if necessary. At the bottom end, the tubular container 2 is provided with a bottom 3, in the exemplary 25 embodiment shown a dome-shaped bottom 3. At its bottom end, the test tube is further provided with an optically readable coding 9, in the form of a dot matrix. Said optically readable coding is applied to an optically substantially opaque surface, i.e. a surface or background which is opaque to the optical reading mechanism to be used, so that the reading 30 with the optical reading mechanism cannot be interfered with as a result of substances, powders, liquids or solid particles present in the test tube. The term "optically opaque" is thus related to the optical reading mechanism used, and in general will amount to said surface or background also being opaque to the human eye. The optically substantially opaque 35 surface is indicated by 7.

The test tube shown in Fig. 1 and Fig. 2a relates to a test tube with a length of approximately 40 mm and an external diameter of approximately 8.5 mm. The surface available on surface 7 for the optical code, i.e. the dot code, has a diameter of approximately 3 mm. The

material of which the tubular container is made in this embodiment is a transparent PP plastic.

The optically substantially opaque surface 7 is substantially flat and directed downwards, so that it extends crosswise to the lengthwise direction of the tubular container 2. This means that the optical coding can be read from underneath with an optical reading mechanism, the term "from underneath" being related to a vertical position of the test tube shown in Figs. 2a and 2b.

The optically opaque surface 7 in the case of the test tube according to Fig. 1 is applied to a carrier part 6 fixed at the bottom end of the tubular container 2, which carrier part can be made of, for example, polystyrene or ABS. Said carrier part 6 in the case of Figs. 1 and 2a is a disc-like element which is enclosed in a space bounded at the top side by the bottom 3 of the tubular container 2 and bounded in the circumferential direction by an extension 22 of the longitudinal side wall of the tubular container 2. Lugs 8 are formed on the underside of the extension 22, for keeping the carrier part 6 confined in the space thus formed. The carrier part 6 can be a plastic element injected into said space, but it can also be a disc pressed into the space along the two lugs 8.

Fig. 2b illustrates an alternative embodiment of a test tube according to the invention which is provided with a carrier part. In this case only the bottom end of the test tube is shown. The tubular container in this case is indicated by 12, the carrier part by 16, the optically opaque surface by 17, the coding applied thereto by 19, and the bottom of the tubular container by 13. The carrier part 16 shown in Fig. 2b can be regarded as a tubular container with a cylindrical circumferential wall and a closed bottom. The optically substantially opaque surface 17 to which the coding 19 has been applied is then situated on the underside of the bottom. The tubular container 12 is pressed from the top with its bottom end into the cavity enclosed by the carrier part 16 and can be connected to the carrier part 16 by gluing, clamping or in some other way. According to an advantageous embodiment, one or more outward projecting retaining lugs are formed on the outer circumference of the tubular container 12 at the bottom end thereof, in order to fix the tubular container 12 to the carrier part 16, which retaining lugs can engage in corresponding retaining recesses formed in the inside wall of the cylindrical part of the carrier part 16. In this way a snap connection can be produced between the carrier part and the tubular container.

The provision of the optically substantially opaque surface and/or the optical coding (thereon) by means of a separate carrier part has the advantage that it is possible to use a carrier part with properties which are optimal for forming an optically substantially  
5 opaque surface, or at any rate an optically substantially opaque background, or for applying thereto an optically substantially opaque surface and applying an optical coding to the optically substantially opaque surface. These properties, in particular the material properties, are in fact generally not found in the test tubes used in practice. This  
10 means that in the case of the test tubes used in practice it is very difficult or even impossible to apply an optically readable coding thereto in a suitable and reliable manner. Moreover, most test tubes in practice are transparent, which would mean that an optically opaque surface would then first have to be formed on the tubular container.

15 Fig. 7 shows a further variant of a test tube according to the invention. Fig. 7 shows disassembled the bottom part of a test tube 100, which consists of a tubular container 102 with a bottom end 110 and a supporting collar 105, which has the same function as the supporting collar 5 of the test tube from Figs. 1 and 2a. The bottom end 110 of the  
20 tubular container 102 is provided on the outside in the outside wall with an annular groove 103 extending around the entire circumference. The bottom end 110 is further provided with four (only two are visible) channels 104 in the form of grooves 104 extending from the bottom end 101 of the tubular container 102 up to, and even slightly beyond, the annular  
25 groove 103. Said grooves 104 and 103 can be provided by cutting material out of a tubular container 102 accordingly at its bottom end, but these grooves 103 and 104 can also be formed directly during the injection moulding of such a tubular container, by providing the injection mould with correspondingly complementary parts. For the sake of clarity, a  
30 carrier part 112 is shown as a separate part below the tubular container 102. This carrier part 112 consists of a plate 107 which at its underside, (not visible) is substantially flat, and is provided with a dot code burned in by means of a laser technique, and consists of four arms 108 and a ring 109 interconnecting the arms 108. Four recesses 111  
35 are formed between the arms 108 and the ring 109. It will be clear from Fig. 7 that the carrier part 112 and the bottom end 110 of the tubular container 102 fit precisely into each other in a manner which is such that the projecting parts 106 are ultimately situated precisely in the recesses 111, and the plate 107 is ultimately situated under the bottom

101 of the tubular container 102. The carrier part 112 in this case is, as it were, a sort of basket which can accommodate the bottom end 110 of the tubular container 102 in a close-fitting manner. When the carrier part 112 is situated on the bottom end 110 of the tubular container 102, the arms 108 and the ring 109 will preferably not project relative to the essentially cylindrical tubular external surface 115 of the tubular container 102. The plate 107 will preferably also be slightly recessed in the bottom end, in such a way that the bottom ends of the parts 106 project beyond the plate 107. In this way it is ensured that the bottom surface of the plate 107 is slightly protected by the projecting bottom ends of the parts 106. The carrier part 112 can easily be directly injected onto or gated into the bottom end 110 of the tubular container. This can be carried out simultaneously with the injection moulding of the tubular container 100, but also in a second step after the tubular container 100 has been formed by injection moulding. It will be clear that the projecting parts 106 form, as it were, retaining projections and that the grooves 104 and 103 form, as it were, retaining recesses.

Figs. 3, 4 and 5 show a storage and/or transportation rack according to the invention, in which a multiplicity of test tubes according to the invention can be accommodated in such a way that the test tubes can be read from the "underside" of the rack with an optical reading mechanism. This rack will be discussed in greater detail below.

The rack 30 consists substantially of a plate 31 which has therein a matrix pattern of 3 x 12 accommodation positions 32 in the form of passages formed through the plate 31. A test tube 1 according to the invention can be placed in each accommodation position 32, by inserting said test tube with its bottom end into an accommodation position. The test tubes 1 inserted into an accommodation position 32 then remain with their supporting collar 5 resting on the plate 31. The centre-to-centre distance between adjacent accommodation positions 32 is approximately 9 mm in this example.

The rack 30 can also optionally be provided with a locking slide 33 with twelve parallel slits, each overlapping a row of eight accommodation positions 32. Each slit 34 is provided with a series of knurls 35, provided opposite each other and facing each other on either side of each slit 34. The distance between two adjacent knurls 35 situated along one side of the slit 34 is equal to the centre-to-centre distance between two adjacent accommodation positions 32. The distance between two knurls 35 situated opposite each other is smaller than the

diameter of the supporting collar 5 and equal to or slightly greater than the diameter of the tubular container 2 directly above the supporting collar 5. The slide 33 at its underside is provided with a sliding or guide mechanism, comprising four L-shaped hooks 36, which fit into the recesses 38 formed in the plate 31. When the slide 33 is inserted with its hooks 36 into the recesses 38, the slide 33 can be moved to and fro in the direction of arrow V, in which case the movement of the slide 33 is limited by the recesses 38 interacting with the vertical parts 39 of the L-shaped hooks 36. The slide 33 is thus slidable to and fro between a releasing position shown in Fig. 4 and a locking position shown in Fig. 5. In the releasing position it is possible to lift test tubes out of the rack, through the fact that between the knurls 35 the slits 34 have sufficient width to allow the supporting collar 5 of the test tubes 1 to pass. In the locked state shown in Fig. 5 the test tubes 1 are fixed in the plate 31 by the fact that the knurls 35 have been slid over the supporting collars 5. It goes without saying that the slide 33 can be fixed in the locking position shown in Fig. 5 by means of locking means (not shown). It will be clear that the sliding or guide mechanism can also be designed differently.

The rack 30 is optically open, i.e. optically transparent, at its underside, so that a reading mechanism placed below the rack 30 and reading in the vertically upward direction can read off the optically readable codings applied to the underside of the test tubes 1. This can be achieved easily in the case of rack 30, as shown in Fig. 3, by designing the rack 30 as an inverted, thin-walled tray which is physically open at the bottom (as shown in Fig. 3) or as a solid plate with recesses 32 (as shown in Fig. 6). In this Fig. 6 an optical reader 52 is also shown very diagrammatically, which optical reader, as will be clear from Fig. 6, can read off from underneath the optical coding on the underside of the test tubes 1.

Fig. 6 shows very diagrammatically an assembly containing a rack 30 and an optical reading mechanism 50. The optical reading mechanism 50 consists of a supporting frame 51 for supporting the rack 30 to be placed thereon. A region 53 is formed in the supporting frame, situated under a rack 30 placed thereon, in which region 53 an optical reader 52 is fitted, which optical reader can be moved through this region by means of an electronically controlled control unit. The optical coding on the underside of each test tube placed in the rack 30 can be read out by means of said reader 52. It is also conceivable if desired to

provide the region 53 with one optical reader which can read out the codings on the underside of all test tubes simultaneously. The reader 52 shown can read out the codings per test tube or the codings of groups of test tubes simultaneously.

5           The frame 50 is further provided with a recess 54, which can interact with a lug 54 on the rack 30, in order to fix the orientation of the rack 30 unequivocally relative to the frame 51.

          The data read by the optical reader can be transmitted by means of a cable 56 with a plug 57 to a further processing unit, such as a  
10   computer.

          With the aid of such an assembly it thus becomes possible to store all data relating to the tubes present in a rack in a computer or other data storage device. The advantages which can be achieved hereby are wide-ranging and will be clear straight away without further  
15   explanation.

          Instead of moving the optical reader itself, it is also conceivable to move the rack over or along the optical reader. The supporting frame could in that case be, for example, a guide plate, guide rails or a roller track.

Claims

1. Test tube, comprising a tubular container (2, 12), which tubular container at its bottom end is provided with an optically readable coding (9, 19) such as a dot code, characterized in that the  
5 optically readable coding is applied to an optically substantially opaque background (7, 17).
2. Test tube according to Claim 1, characterized in that said background has a surface which is substantially flat and faces downwards, and extends substantially in the crosswise direction of the tube.
- 10 3. Test tube according to one of the preceding claims, characterized in that said background or said surface is provided by or applied to a carrier part (6, 16) fixed to the bottom end of the tubular container (2, 12).
4. Test tube according to Claim 3, characterized in that the  
15 carrier part is made of a material which is different from the material from which the tubular container is made and is suitable for the application of the optically readable coding.
5. Test tube according to Claim 4, characterized in that the material of the carrier part is suitable for burning in the optically  
20 readable coding by means of a laser technique, which coding is preferably a fine dot code with a centre-to-centre distance between the dots of less than 0.5 mm, preferably less than 0.4 to 0.35 mm.
6. Test tube according to Claim 5, characterized in that the dots have a diameter of less than approximately 200  $\mu\text{m}$ , preferably  
25 approximately 150 to 175  $\mu\text{m}$  or smaller.
7. Test tube according to one of Claims 3 - 6, characterized in that the carrier part is a part moulded onto the tubular container, such as a gated-in plastic part.
8. Test tube according to one of Claims 3 - 7, characterized in that  
30 that the tubular container comprises retaining means (8, 18), such as a retaining lug or retaining recess, at its bottom end, for fixing the carrier part (6, 16) to the tubular container (2, 12).
9. Test tube according to one of Claims 3 - 8, characterized in that the carrier part (16) comprises at its top side a cavity in which  
35 the bottom end of the tubular container (12) is accommodated, and in that the carrier part and the bottom end are fixed to each other by means of a snap connection (18).
10. Test tube according to one of Claims 3 - 8, characterized in



that the side wall of the tubular container (2) at its bottom end is extended (22) beyond the bottom (3) of the tubular container (2), in order to form a space below said bottom for accommodating the carrier part (6).

5 11. Test tube according to Claim 10, characterized in that the bottom end of the extended side wall (22) is provided with at least one retaining lug (8) pointing into the space.

12. Test tube according to Claim 10 or 11, characterized in that the carrier part (6) is a plastic part injected into the space.

10 13. Test tube according to Claim 11, characterized in that the carrier part (6) is an element (6) which is fixed by snapping between the at least one retaining lug (8) and a further stop member (3), such as the bottom of the tubular container.

14. Test tube according to one of Claims 1 - 13, characterized in  
15 that at its bottom end the tubular container is provided with an annular groove formed on the outside, which groove extends over at least part of, but preferably over the entire circumference of the container, and in that at its bottom end the tubular container is further provided with one or more, preferably two, three or four, channels extending from the  
20 annular groove to substantially the bottom end of the tubular container, and in that the carrier part comprises:

- a plate situated at the bottom end of the tubular container;
- arms extending from the plate through the channels to the annular groove; and
- 25 - a ring extending through the groove;

the plate, the arms and the ring being formed integrally of plastic, and the arms and the ring retaining the plate at the bottom end of the container.

15. Test tube according to Claim 13, characterized in that the  
30 channels are grooves formed in the outside wall of the container.

16. Test tube according to Claim 12 or 13, characterized in that the carrier part accommodates the bottom end of the container in a close-fitting manner as a sort of basket, the free spaces in the wall of the basket-type part accommodating projecting parts at the bottom end of the  
35 container.

17. Test tube according to one of the preceding claims, characterized in that the tubular container (2, 12) is made of polypropylene or polypropene or polystyrene.

18. Test tube according to one of the preceding claims,

characterized in that the test tube is transparent.

19. Test tube according to one of the preceding claims,

characterized in that the carrier part, or at any rate the part to which the coding is applied, comprises polystyrene, ABS or a plastic filled

5 with titanium white or zinc white, possibly in the form of a mixture with another substance/another material, such as a plastic.

20. Storage or transportation rack (30), with a multiplicity of accommodation positions (32) for accommodating therein test tubes (1)

10 according to one of the preceding claims, the accommodation positions (32) being optically open at the underside, in such a way that the optically readable coding (9, 19) of test tubes (1) to be placed therein can be read from the "underside" of the rack (30) with an optical reading mechanism (50, 52).

21. Storage or transportation rack according to Claim 20, in which  
15 test tubes according to one of Claims 1 - 18 are accommodated in at least a number of the accommodation positions, possibly in all accommodation positions.

22. Storage or transportation rack according to Claim 20 or 21,  
20 characterized in that the rack has 96 accommodation positions placed in a 12 x 8 matrix pattern.

23. Assembly comprising a rack (30) according to one of Claims 20 - 22 and an optical reading mechanism or optical reader.

24. Assembly comprising a rack (30) according to one of Claims 20 - 23 and an optical reading mechanism (50), the optical reading mechanism  
25 (50) comprising a supporting frame (51) for supporting the rack (30) to be placed thereon, in which a multiplicity of substantially vertically oriented test tubes (1) can be placed, and a reader (52) fitted in the supporting frame (51) and reading substantially in the vertical, upward direction.

30 25. Assembly according to one of Claims 23 - 24, in which the optical reading mechanism (50) is provided with a microprocessor which is equipped to allocate the codings which have been read to the accommodation positions (32) in the rack (30).

26. Assembly according to one of Claims 23 - 25, in which the rack  
35 (30) and the optical reading mechanism (50) are provided with means (54, 55) for unequivocally determining or recording the position or orientation of the rack (30) relative to that of the reading mechanism (50) or the frame (51) thereof.

1/4

fig-1

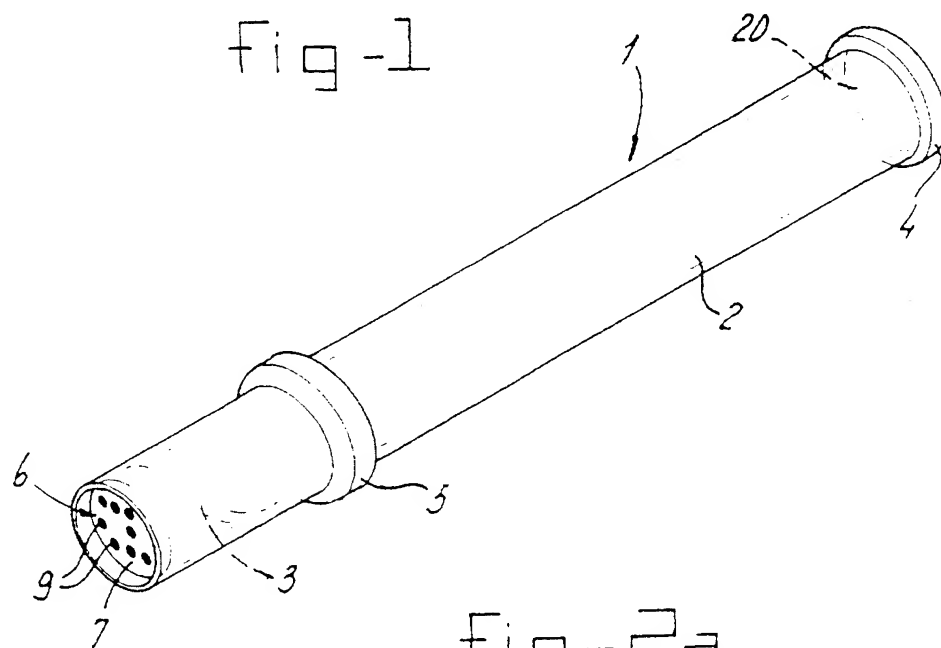


fig-2a

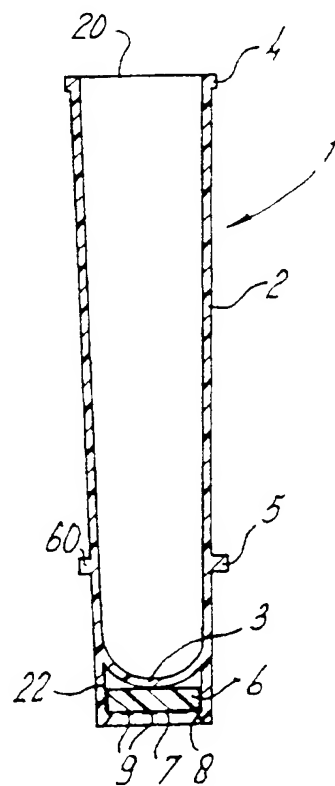
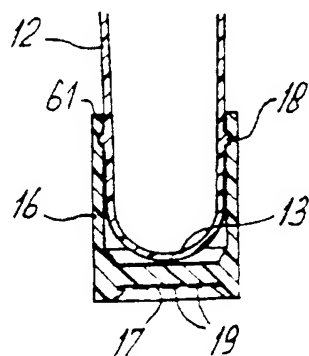


fig-2b



2/4

fig - 3

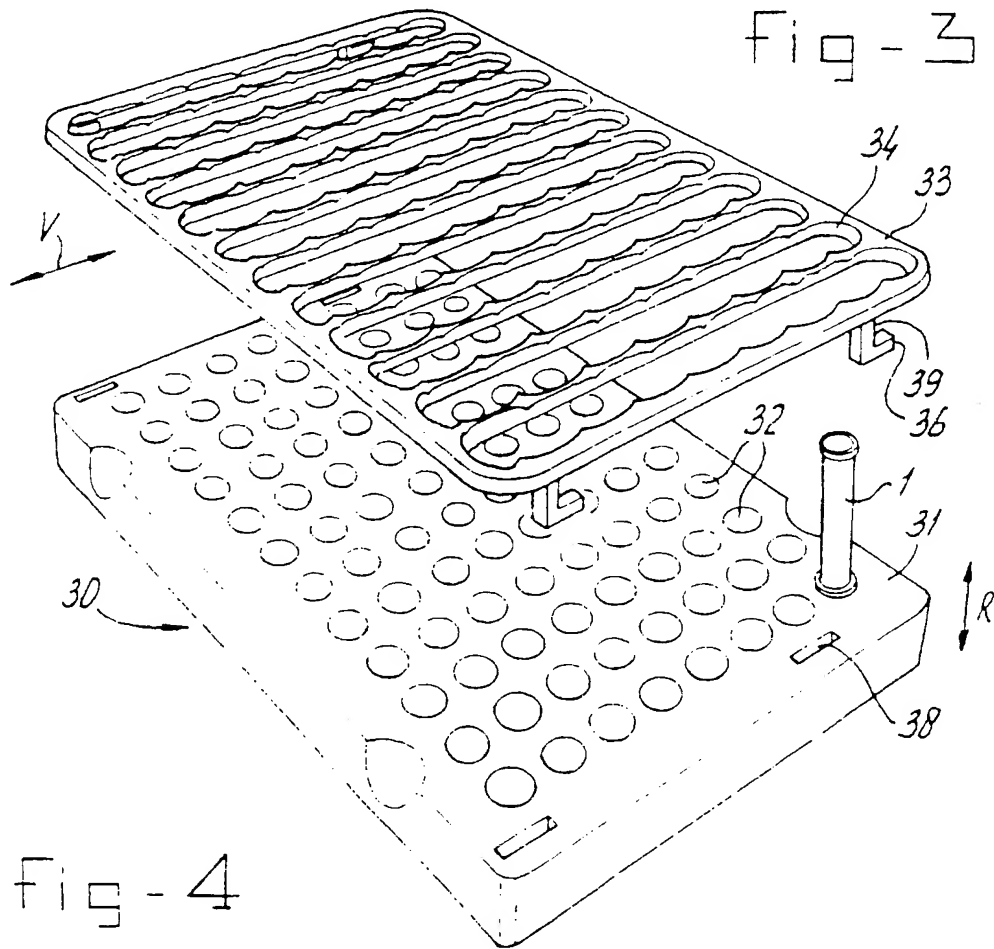


fig - 4

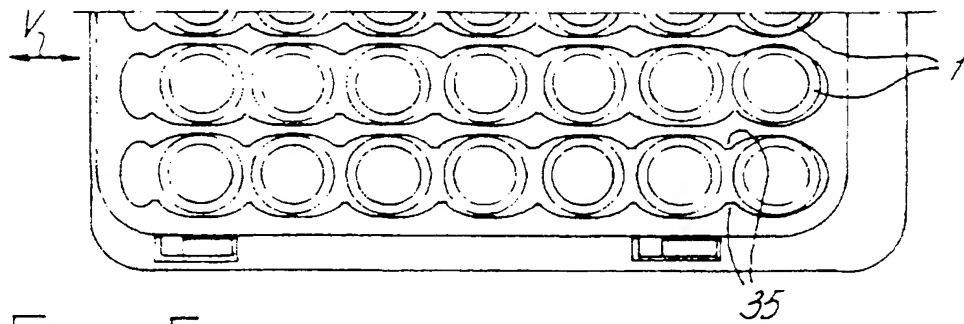
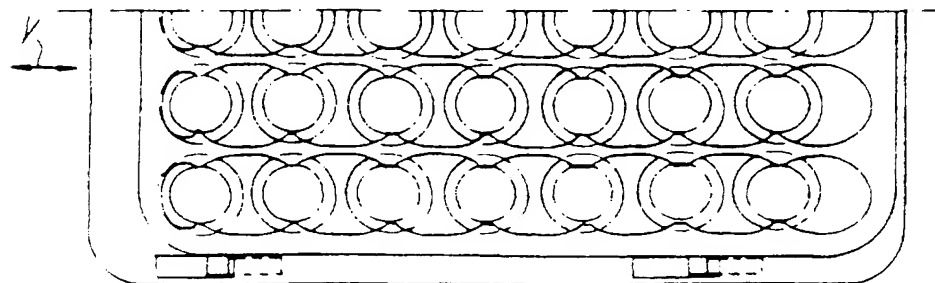
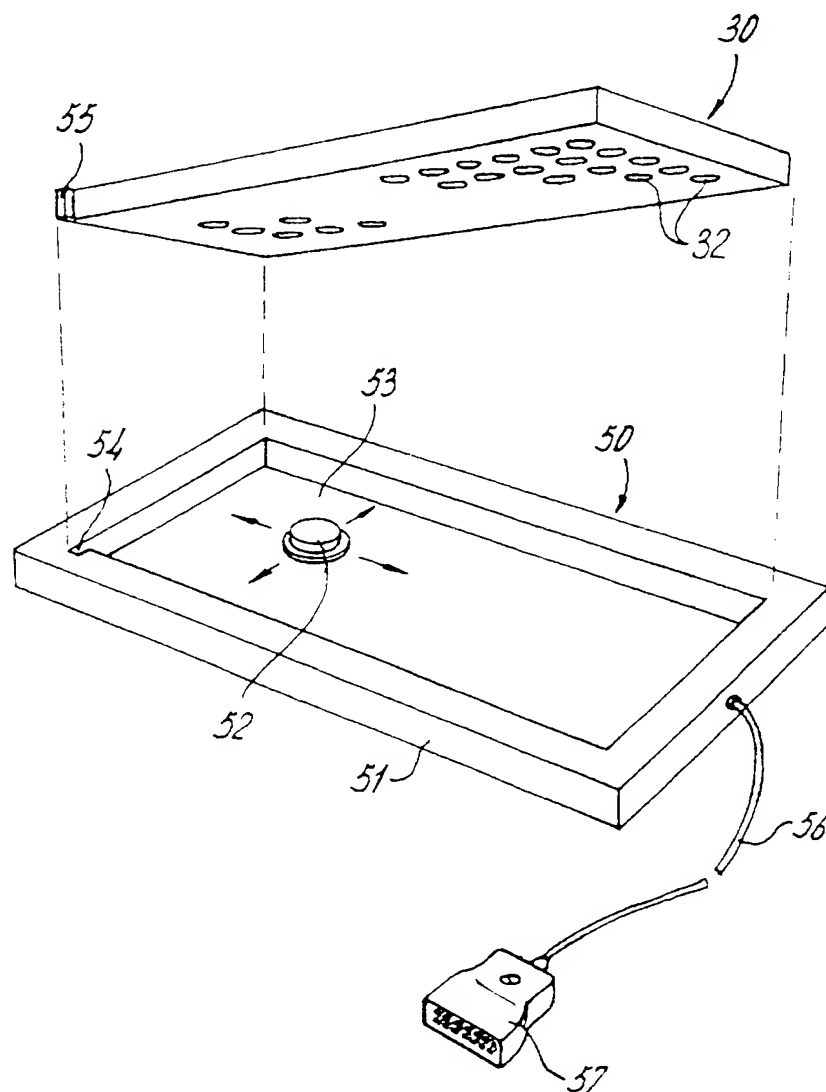


fig - 5



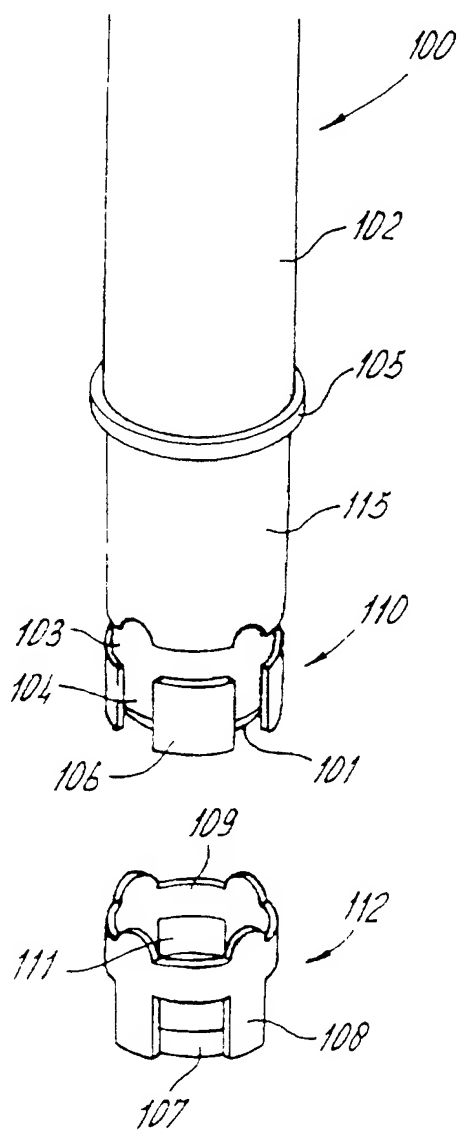
3/4

fig-6



4/4

fig - 7



## INTERNATIONAL SEARCH REPORT

National Application No.

PCT/NL 97/00447

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B01L3/14 B01L9/06 G06K19/06

According to international Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	WO 94 02857 A (SCHIAPPARELLI BIOSYSTEMS INC ; WEYRAUCH BRUCE (US); KELLN NORMAN (U) 3 February 1994	1-4, 20, 21, 23-25
Y	see page 6, line 29 - line 32	19
	see page 7, line 5 - line 9	
X	see page 8, line 11 - line 16; figure 7	26
Y	see page 8, line 17 - line 21	22
Y	see page 9, line 5 - line 10; figures 11, 12	8-10
Y	see page 10, line 16 - line 35; figure 13	5, 6
	see page 15, line 28 - line 33	
	---	
Y	US 5 175 774 A (TRUAX RODNEY D ET AL) 29 December 1992	5, 6
	see column 1, line 24 - line 30	
	see column 3, line 33 - line 56	
	see column 5, line 36 - line 54	
	see column 6, line 58 - column 7, line 11	
	---	
	-/--	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

7 November 1997

Date of mailing of the international search report

18/11/1997

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel: (+31-(0) 340-2040, Tx 31 651 epo nl  
Fax: (+31-(0) 340-3016

Authorized officer

Hocquet, A

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 97/00447

## C. (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate of the relevant passages	Relevant to claim No
Y	WO 89 08264 A (BALLIES UWE W) 8 September 1989 see page 8, line 31 - page 9, line 6	8,9
A	see figure 2	13
A	see figure 1	14
Y	FR 2 266 641 A (AUTOMATISME CIE GLE) 31 October 1975 see page 3, line 6 - line 14; figure	10
Y	US 3 818 188 A (HERTEL G ET AL) 18 June 1974 see column 2, line 10 - line 14	19
Y	US 5 080 232 A (LEONCAVALLO RICHARD A ET AL) 14 January 1992 see figures 1,13	22
A	EP 0 569 835 A (LEOPARDI FRANCESCO ;PAOLETTI SERGIO (IT)) 18 November 1993 see page 1, line 1 - line 3 see column 3, line 50 - column 4, line 3 see column 8, line 7 - line 30; figures	7,12
A	WO 96 08433 A (CLIDS OY ;RIEKKINEN MARTTI (FI)) 21 March 1996 see page 7, line 19 - page 8, line 27; claim 1; figures 1-3	1-3,8, 20,23-25
A	EP 0 645 187 A (PACKARD INSTRUMENT CO INC) 29 March 1995 see page 5, line 12 - line 16; figure 2	26
A	FR 2 649 511 A (ARCHITECT) 11 January 1991 see figures 1-4	22
A	US 4 990 792 A (FREI MATTHIAS) 5 February 1991 see column 1, line 11 - line 61 see column 1, line 58 - line 66 see column 2, line 45 - line 53 see column 3, line 29 - line 50 see column 5, line 33 - line 67; figures 4,5	5,19
P,A	WO 97 18896 A (CLIDS OY ;IKONEN PASI (FI); TUONONEN REIJO (FI)) 29 May 1997 see page 3, line 20 - page 4, line 2; figures	1
A	WO 96 07479 A (GAY FRERES) 14 March 1996 see page 6, line 6 - line 24; figure 4 see page 7, paragraph 2; figure 5	22



## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 97/00447

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9402857 A	03-02-94	US 5357095 A AU 3437893 A DE 69309068 D EP 0651884 A US 5420408 A	18-10-94 14-02-94 24-04-97 10-05-95 30-05-95
US 5175774 A	29-12-92	NONE	
WO 8908264 A	08-09-89	NONE	
FR 2266641 A	31-10-75	NONE	
US 3818188 A	18-06-74	DE 2153214 A FR 2158917 A NL 7214295 A	03-05-73 15-06-73 01-05-73
US 5080232 A	14-01-92	CA 2016526 A	01-12-90
EP 0569835 A	18-11-93	IT MI921139 A AU 678551 B AU 4087493 A CA 2112985 A IL 105627 A WO 9323165 A JP 6509015 T KR 9710165 B MX 9302779 A US 5433716 A	15-11-93 05-06-97 13-12-93 25-11-93 14-05-96 25-11-93 13-10-94 21-06-97 01-11-93 18-07-95
WO 9608433 A	21-03-96	AU 7616994 A EP 0783445 A	29-03-96 16-07-97
EP 0645187 A	29-03-95	NONE	
FR 2649511 A	11-01-91	NONE	
US 4990792 A	05-02-91	CH 676644 A AT 124555 T DE 3829025 A DE 58909317 D	15-02-91 15-07-95 15-02-90 03-08-95

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 97/00447

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4990792 A		EP 0354362 A	14-02-90
WO 9718896 A	29-05-97	FI 955611 A	23-05-97
		AU 7575096 A	11-06-97
WO 9607479 A	14-03-96	NONE	

New Claims

1. Test tube, comprising a tubular container (2, 12) and a carrier part (6, 16) which  
5 is provided at the bottom end of the container and provided with a coding (9, 19), such  
as a dot code, readable with an optically reading mechanism and in which the carrier  
part (6, 16) is fixed to the bottom end of the tubular container and has a substantially  
flat, downwardly facing surface carrying the coding, characterized in that the carrier part  
(6, 16) is made of a material:
- 10 - which is different from the material from which the tubular container is made;  
- which is suitable for burning in the optically readable coding by means of a laser  
technique; and  
- which, between the optical coding and the tubular container, provides a  
background which is opaque to the optical reading mechanism.
- 15 2. Test tube according to claim 1, in which the coding is a fine dot code with a  
centre-to-centre distance between the dots of less than 0,5 mm, preferably less than 0,4  
to 0,35 mm and in which the dots have a diameter of less than approximately 200  $\mu\text{m}$ ,  
preferably approximately 150 to 175  $\mu\text{m}$  or smaller.
- 20 3. Test tube according to claim 1 or 2, in which the side wall of the tubular container  
(2) at its bottom end is extended (22) beyond the bottom (3) of the tubular container (2),  
in order to form a space below said bottom in which the carrier part (6) is  
accommodated.
4. Test tube according to Claim 3, in which the carrier part (6) is a plastic part  
injected into the space.
- 25 5. Test tube according to Claim 3 or 4, in which the bottom end of the extended side  
wall (22) is provided with at least one retaining lug (8) pointing into the space.
6. Test tube according to Claim 5, in which the carrier part (6) is an element (6)  
which is fixed by snapping between the at least one retaining lug (8) and a further stop  
member (3), such as the bottom of the tubular container.
- 30 7. Test tube according to one of Claims 1 - 6, in which the carrier part is a part  
moulded onto the tubular container, such as a gated-in plastic part.

8. Test tube according to one of Claims 1 - 7, in which the tubular container comprises retaining means (8, 13), such as a retaining lug or retaining recess, at its bottom end, for fixing the carrier part (6, 16) to the tubular container (2, 12).
9. Test tube according to one of Claims 1 - 2, in which the carrier part (16) comprises at its top side a cavity in which the bottom end of the tubular container (12) is accommodated, and in that the carrier part and the bottom end are fixed to each other by means of a snap connection (18).
10. Test tube according to one of Claims 1 - 9, in which at its bottom end the tubular container is provided with an annular groove formed on the outside, which groove extends over at least part of, but preferably over the entire circumference of the container, and in that at its bottom end the tubular container is further provided with one or more, preferably two, three or four, channels extending from the annular groove to substantially the bottom end of the tubular container, and in that the carrier part comprises:
  - 15 - a plate situated at the bottom end of the tubular container;
  - arms extending from the plate through the channels to the annular groove; and
  - a ring extending through the groove;the plate, the arms and the ring being formed integrally of plastic, and the arms and the ring retaining the plate at the bottom end of the container.
- 20 11. Test tube according to Claim 10, in which the channels are grooves formed in the outside wall of the container.
12. Test tube according to Claim 10 or 11, in which the carrier part accommodates the bottom end of the container in a close-fitting manner as a sort of basket, the free spaces in the wall of the basket-type part accommodating projecting parts at the bottom end of
- 25 the container.
13. Test tube according to one of the preceding claims, in which the tubular container (2, 12) is made of polypropylene or polypropene or polystyrene.
14. Test tube according to one of the preceding claims, in which the test tube is transparent.
- 30 15. Test tube according to one of the preceding claims, in which the carrier part, or at any rate the part to which the coding is applied, comprises polystyrene, ABS or a plastic filled with titanium white or zinc white, possibly in the form of a mixture with another substance/another material, such as a plastic.

16. Storage or transportation rack (30), with a multiplicity of accommodation positions (32) for accommodating therein test tubes (1) according to one of the preceding claims, the accommodation positions (32) being optically open at the underside, in such a way that the optically readable coding (9, 19) of test tubes (1) to be placed therein can be read from the "underside" of the rack (30) with an optical reading mechanism (50, 52).
17. Storage or transportation rack according to Claim 16, in which test tubes according to one of Claims 1 - 15 are accommodated in at least a number of the accommodation positions, possibly in all accommodation positions.
18. Storage or transportation rack according to Claim 16 or 17, in which the rack has 96 accommodation positions placed in a 12 x 8 matrix pattern.
19. Assembly comprising a rack (30) according to one of Claims 16 - 18 and an optical reading mechanism or optical reader, the background provided by the coding carrier being opaque to said optical reading mechanism respectively optical reader.
20. Assembly according to claim 19, the optical reading mechanism (50) comprising a supporting frame (51) for supporting the rack (30) to be placed thereon, in which a multiplicity of substantially vertically oriented test tubes (1) can be placed, and a reader (52) fitted in the supporting frame (51) and reading substantially in the vertical, upward direction.
21. Assembly according to one of Claims 19 - 20, in which the optical reading mechanism (50) is provided with a microprocessor which is equipped to allocate the codings which have been read to the accommodation positions (32) in the rack (30).
22. Assembly according to one of Claims 19 - 21, in which the rack (30) and the optical reading mechanism (50) are provided with means (54, 55) for unequivocally determining or recording the position or orientation of the rack (30) relative to that of the reading mechanism (50) or the frame (51) thereof.